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ABSTRACT

Using data on the growth of information related businesses in Texas in the period from 1971 to 1981, this paper analyzes and interprets the results in the context of demographic changes and educational policy in Texas. To track the number of businesses that fall into the information sector, and to reveal trends in growth and in industry consolidation, the study applies a model developed by Marc Porat to current census data for individual industries classified by Standard Industrial Classification (SIC) codes. To refine estimates of growth, the study further classifies businesses by number of employees. State data on changes in the Texas information sector are presented for small, medium, and large businesses within each of seven categories: (1) knowledge production and inventive industries; (2) information distribution and communication industries; (3) search and coordination industries; (4) risk management industries; (5) information processing and transmission services; (6) information goods manufacturing industries; and (7) wholesale and retail trade in information goods. Comparisons are made with national aggregate data for the same period. Implications of information sector growth for employment and for state policy makers and educators are also discussed. (THC)

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The Growth of the Information Sector in Texas

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The Growth of the Information Sector in Texas

1. Introduction

The growing list of new information technologies and the corresponding applications of these technologies offer undeniable evidence of the growing importance of "information work" in the domestic economy. The activity of "producing, processing, and distributing information" (Porat, 1977) may now account for at least 50% of U.S. economic activity. But what about economic activity at the state level? Many states are currently attempting to attract high technology information sector industries to diversify their economic base and provide new jobs. At the same time, federal anxiety about education has been felt at state and local levels, as educators and citizens grapple with the problems of apparently declining achievement levels and inappropriate curricula.

This paper posits that there is a relationship between the change in the economy and educational needs, and that these issues must be considered within a demographic context. We apply this approach to an analysis of the information sector in Texas, using data on the growth of information related businesses from 1971 to 1981. We then interpret the results of this analysis in the context of demographic changes and educational policy in Texas.

2. Defining The Information Sector

As information activities have become a major force in the economy, communication researchers and economists have attempted to define and quantify the information sector. This task has been difficult for two reasons. First, the broad nature of information and communication makes a specific definition hard to formulate. Second, for purposes of classification, economists first formulated the traditional sectors of the economy during a period when industrial processes dominated economic activity, with the service sector achieving only secondary importance.

Information activities span all of the traditional economic sectors. Computer manufacturers and book binders belong to the industrial sector, while advertising agencies, schools, and libraries are part of the service sector, yet each of these industries contributes to the information sector as well.

Porat (1977) attempted to list and classify the industries that constitute the information sector. Porat defines "information industries" as those which offer goods and services that "intrinsically convey information" or are "directly useful in producing, processing, or distributing information." Porat identifies primary and secondary information sectors. The primary sector includes all industries that produce information

machines or market information as a commodity.

The secondary sector consists of the "private and public bureaucracies" which are handlers or users of information. Information activities -- which include management, financial control, scheduling, reservations, inventory control, research, marketing, and database management, etc. -- are the major functions of many government and business entities. Their contribution is more difficult to determine, because the output is not information products, but other goods and services. Bell estimated that about 54% of information sector activity can be attributed to the primary sector, and 46% to the secondary sector (Bell in Forester, 1981).

3. Methodology Used in this Study

The results of Porat's study demonstrate the significant contribution of the information sector to the domestic economy. Unfortunately, the study has not been updated, and the decade following his research has brought major changes and dramatic growth in the information sector.

To attempt to obtain a rough estimate of the growth of the information sector in recent years, one approach is to apply Porat's model of the information economy to current census data. The U.S. Census Bureau publishes data for individual industries classified by Standard Industrial Classification (SIC) codes which Porat also used in his model. For any industry, data are provided for the total number of businesses within the industry, the total number of receipts, the number of employees, and the amount of the actual payroll.

Our application of Porat's model tracks the number of businesses within the industries that fall into the information sector definition. An alternative approach might track the amount of total receipts for the information industries. This method, however, would tend to over-estimate the sector by duplicating revenues across several types of businesses. For example, when a bookstore makes a sale, a publishing company, a printer, a bookbinder, and a distributor have each already recorded the sale of the product.

Thus the present research focuses on applying Porat's model to the number of businesses within the industries of the information sector. To refine the estimates of growth, our analysis has further classified businesses by the number of persons employed:

-- small businesses: employing up to 100 people;

-- medium businesses: employing 101 to 500 people;

-- large businesses: employing over 500 people.

While this use of Porat's typology does not reflect the accuracy of his original study, it does offer several practical advantages:

-- a researcher may gather data for a specific state, rather than working at the aggregated national economic level;

-- the data are readily accessible in Bureau of the Census reports;

-- the calculations are simple, requiring no economic modeling or complex programming;

-- analysis of the data reveals not only trends in growth, but trends in industry consolidation;

-- research may focus on specific categories of the information sector;

-- the standardized SIC codes allow comparison to other states or to the nation as a whole.

4. The Growth of the Information Sector in Texas

4.1 Information Sector Categories

The following analysis presents changes in the information sector as a whole in Texas between 1971 and 1981, and in the categories identified by Porat. Within each category, state data are presented by small, medium, and large businesses. Comparisons are made with national aggregate data for the same period.

Porat devised seven broad categories which form a typology for information sector activity (see Table 1):

i. Knowledge Production and Inventive Industries

The main activities of industries in this category are research and development, invention, and information gathering. A visible Texas example of this type of industry is Microelectronics and Computer Technology Corporation (MCC) which is located in Austin. MCC is a cooperative research venture that will pool the research resources of major information sector companies in areas including artificial intelligence, advanced computer architecture, and database management. Research and development has also become an increasingly important activity within existing businesses. Average expenditures on R&D by corporations have increased 16% between 1978 and 1982, and now claim an average of 2.4% of annual sales revenues (Business Week, March 22, 1984).

Table 1: Detailed Typology of the Primary Information Sector

MARKETS FOR INFORMATION

KNOWLEDGE PRODUCTION AND INVENTIVE INDUSTRIES

R&D and Inventive Industries

(7391) Commercial Research and Development Laboratories
(7397) Commercial Testing Laboratories
(8921) Nonprofit Education and Scientific Research Agencies

Private Information Services

(6281) Services Allied with the Exchange of Securities or Commodities
(6611) Combinations of Real Estate, Insurance, Loans, Law Offices
(7392) Business, Management, Administrative, and Consulting Services
(8111) Legal Services
(8911) Engineering and Architectural Services
(8931) Accounting, Auditing, and Bookkeeping Services
(8999) Services, Not Elsewhere Classified

INFORMATION DISTRIBUTION AND COMMUNICATION INDUSTRIES

Education

(8211) Elementary and Secondary Schools
(8221) Colleges, Universities, and Professional Schools
(8222) Junior Colleges and Technical Institutes
(8241) Correspondence Schools
(8242) Vocational Schools, Except Vocational High Schools
(8299) Schools and Educational Services, Not Elsewhere Classified

Public Information Services

(8231) Libraries and Information Centers

Regulated Communication Media

(4832) Radio Broadcasting
(4833) Television Broadcasting

Unregulated Communication Media

(2711) Newspapers: Publishing, Publishing and Printing
(2721) Periodicals: Publishing, Publishing and Printing
(2731) Books: Publishing, Publishing and Printing
(2741) Miscellaneous Publishing
(7351) News Syndicates
(7812) Motion Picture Production, Except for Television
(7814) Motion Picture and Tape Production for Television
(7815) Production of Still and Slide Films
(7816) Motion Picture Film Exchange
(7817) Film or Tape Distribution for Television
(7821) Motion Picture Service Industries
(7922) Theatrical Producers (Except Motion Picture) and Miscellaneous Theatrical Services

INFORMATION IN MARKETS

SEARCH AND COORDINATION INDUSTRIES

Search and Non-Speculative Brokerage Industries

(6052) Foreign Exchange Establishments
(6053) Check Cashing Agencies and Currency Exchanges
(6055) Clearing House Associations
(6161) Loan Correspondents and Brokers
(6231) Security and Commodity Exchanges
(6411) Insurance Agents, Brokers, and Service
(6531) Agents, Brokers, and Managers
(6541) Title Abstract Companies
(7313) Radio, Television, and Publishers' Advertising Representatives
(7321) Consumer Credit Reporting Agencies, Mercantile Reporting Agencies, and Adjustments and Collection Agencies
(7361) Private Employment Agencies
(7398) Temporary Help Supply Services
(7818) Services Allied to Motion Picture Distribution

Advertising Industries

(3993) Signs and Advertising Displays
(7311) Advertising Agencies
(7312) Outdoor Advertising Services
(7319) Miscellaneous Advertising
(7331) Direct Mail Advertising Services

Non-Market Coordinating Institutions

(8611) Business Associations
(8621) Professional Membership Organizations
(8631) Labor Unions and Similar Labor Organizations
(8651) Political Organizations

RISK MANAGEMENT INDUSTRIES

Insurance Industries (Components Only)

(63) Life, Accident, Fire and Casualty
(636) Title Insurance

Finance Industries (Components Only)

(60) Commercial, Savings Banks & Related Institutions
(61) Credit Institutions

Speculative Brokers (Components Only)

(62) Security Brokers, Commodity Contractors
(63) Patent Owners and Lessors

Table 1 continued:

INFORMATION INFRASTRUCTURE

INFORMATION PROCESSING AND TRANSMISSION SERVICES

Non-Electronic Based Processing

Fixed Costs:

(2753) Engraving and Plate Printing
(2791) Typesetting
(2793) Photoengraving
(2794) Electrotyping and Stereotyping

Variable Costs:

(2732) Book Printing
(2751) Commercial Printing, Except Lithographic
(2752) Commercial Printing, Lithographic
(2789) Bookbinding and Related Work
(7221) Photographic Studios, Including Commercial Photography
(7332) Blueprinting and Photocopying Services
(7339) Stenographic Services; and Duplicating Services, Not Elsewhere Classified
(7395) Photofinishing Laboratories

Electronic Based Processing

(7392) Pure Data Processing Services

Telecommunication Infrastructure

(4811) Telephone Communication (Wire or Radio)
(4821) Telegraph Communication (Wire or Radio)
(4899) Communication Services, Not Elsewhere Classified

INFORMATION GOODS MANUFACTURING INDUSTRIES

Non-Electronic Consumption or Intermediate Goods

(2621) Paper Mills, Except Building Paper Mills
(2642) Envelopes
(2761) Manifold Business Forms
(2782) Blankbooks, Loose Leaf Binders and Devices
(2893) Printing Ink
(2895) Carbon Black
(3861) Photographic Equipment and Supplies
(3951) Pens, Pen Points, Fountain Pens, Ball Point Pens, Mechanical Pencils and Parts
(3952) Lead Pencils, Crayons, and Artists' Materials
(3953) Marking Devices
(3955) Carbon Paper and Ink Ribbons

Non-Electronic Investment Goods

(3554) Paper Industries Machinery
(3555) Printing Trades Machinery and Equipment
(3574) Calculating and Accounting Machines, Except Electronic Computing Equipment
(3576) Scales and Balances, Except Laboratory
(3579) Office Machines, Not Elsewhere Classified
(3821) Mechanical Measuring and Controlling Instruments, Except Automatic Temperature Controls
(3822) Automatic Temperature Controls
(3831) Optical Instruments and Lenses

Electronic Consumption or Intermediate Goods

(3652) Phonograph Records
(3671) Radio and Television Receiving Type Electron Tubes, Except Cathode Ray
(3672) Cathode Ray Picture Tubes
(3673) Transmitting, Industrial and Special Purpose Electron Tubes
(3674) Semiconductors and Related Devices
(3679) Electronic Components and Accessories, Not Elsewhere Classified
(5065) Electronic Parts and Equipment

Electronic Investment Goods

(3573) Electronic Computing Equipment
(3611) Electric Measuring Instruments and Test Equipment
(3651) Radio and Television Receiving Sets, Except Communication Types
(3661) Telephone and Telegraph Apparatus
(3662) Radio and Television Transmitting, Signalling, and Detection Equipment and Apparatus
(3693) Radiographic X-ray, Fluoroscopic X-ray, Therapeutic X-ray, and other X-ray Apparatus and Tubes; Electromedical and Electrotherapeutic Apparatus
(3811) Engineering, Laboratory, and Scientific and Research Instruments and Associated Equipment

WHOLESALE AND RETAIL TRADE IN INFORMATION GOODS

Household Investment Goods

(5733) Radio and Television Stores
(5996) Camera and Photographic Supply Stores Hand Calculators

Consumption Goods

(5942) Book Stores
(5994) News Dealers and Newsstands
(7832) Motion Picture Theaters, Except Drive-in
(7833) Drive-in Motion Picture Theaters

SUPPORT FACILITIES FOR INFORMATIONAL ACTIVITIES

(15) Contract Construction of Office, School, Communications Buildings
(65) Rentals of Information Structures
(25) Furnishings for Office Buildings

Source: Porat, 1977

Numbers refer to SIC codes.

Financial, legal, and technical service firms also fall within this category. As the business environment becomes more complex, the demand for specialized expert advice in these fields is likely to grow.

ii. Information Distribution and Communication Industries

Educational institutions and libraries make up a large portion of this category. Changes in this sector are thus difficult to interpret, as they may be influenced by federal or state policies and budgets, and/or demographic changes (in the number of school age children, community residents, etc.) The communication media, of course, also play an important role in information distribution. Porat divides these industries into two classes: those that are regulated (including radio and television broadcasting) and those that are not, including print media and motion pictures. Given the current trends toward "unregulation" and the blurring of boundaries between theses activities and their associated technologies, it is probably best to consider them in terms of their functions rather than their regulatory context.

iii. Search and Coordination Industries

This group of industries performs the role of connecting market forces, i.e. facilitating the interaction of supplier and buyer, or employer and employee, or connecting those with information needs to those with the required information. Within this category are loan brokers, employment agencies, business and professional organizations, advertising agencies, credit agencies, and foreign exchange establishments.

iv. Risk Management Industries

Insurance companies, banks, and securities brokers all belong to this classification since their principal activity is the management of financial risk. They perform an assessment of risk at the aggregate level, and thus achieve value by offering the management of risk for undiversified individuals and corporations. Since the success of such companies comes from making informed judgments from incomplete information, they must perform their "information work" with maximum speed and efficiency. Thus it should be no surprise that these businesses were among the first to adopt new methods of information processing and distribution. For example, many banks now depend on electronic funds transfer and automatic teller machines for a large portion of their business activity. As institutions invest in technology, they make trade offs between people and machines in their production activities -- changing both the level and the nature of their employment mix.

v. Information Processing and Transmission Services

This broad category spans the printing, data processing, and telecommunications industries. This group focuses on the processing of information into its final form -- a book, newspaper, or computer printout. In addition, the telecommunications infrastructure industries transmit information in the form of voice, picture, or data. Technological innovation has somewhat blurred the distinction between companies in each class, since now the functions of printing, processing, and distributing information are easily combined into a single process. For example, a book printer traditionally sets type, prints pages, binds books, and ships them. Now it is possible to input text into a computer, transmit it over telephone lines for editing and typesetting, and then to publish it both in hardcopy and in computer-readable form where it be accessed via telecommunications links from personal computers or terminals.

vi. Information Goods Manufacturing Industries

Porat divided this category in two ways: first between information goods manufacturing for the consumer and for business (consumption vs. investment). He also identified these goods as electronic or non-electronic. The business of manufacturing non-electronic goods has not changed a great deal over past decades. Both individuals and organizations continue to use pens, pencils, paper, and envelopes. Although many of these goods are subject to production cost variations due to fluctuations in the forestry and paper industries, demand has not changed dramatically. Even with the growth of computer use, these firms have found new markets for computer paper and inks. We are still far from a paperless society! In contrast, non-electronic investment goods such as mechanical control devices, non-electronic office machines and printing trade machinery are likely to be replaced by electronic equipment.

Companies manufacturing electronic goods make products such as phonograph records, semiconductors, telephone equipment, computers, and television sets. Although there is great variation in these products, together they form the consumer electronics industry which has expanded dramatically in the past decade.

vii. Wholesale and Retail Trade in Information Goods

Trade in information goods includes enterprises that sell information and telecommunications products ranging from books and newspapers to television sets, cameras and calculators (and now computers). It also includes outlets for consumption of information products such as movie theaters (and now probably video game parlors).

viii. Support Facilities for Information Activities

This category represents facilities and businesses which support the other communications and information industries, including construction companies, renters of space for information production and manufacturing industries and retailers of information goods, and suppliers of office furnishings. The growth in these businesses is logically linked to the growth of industries in the categories above. Since only a portion of the industries is involved directly with the information sector, this category was omitted from the growth analysis.

4.2 Growth in the Information Sector in Texas

Tables 2 and 3 show the growth in the information sector in Texas and in the U.S. during the period 1971 to 1981 for each subsector as defined above. Table 4 shows the businesses in the information sector as a percentage of all businesses in Texas and the U.S. in 1971, 1976, and 1981.

Table 4 indicates that the growth of information sector businesses as a total of all businesses in Texas has paralleled the national trends, at about 15% to 16% of all businesses, but actually fell behind slightly during the decade. However, taken in isolation, this conclusion is misleading, as Tables 2 and 3 show that the percentage growth in information businesses in most subsectors was in fact much higher in Texas. Thus, between 1971 and 1981, the number of information sector businesses in Texas grew 52.35%, while nationally the number of businesses grew 40.26%.

The fact that Texas fell behind in terms of the number of businesses in the information sector as a percentage of all businesses is a function of the much greater growth in all business activity in Texas during the decade. The number of reported businesses in Texas grew 54.9% from 1971 to 1981, while nationally, the growth was 30.6%. Thus the absolute growth in the information sector at the state level is probably the more useful comparison.

However, aggregate statistics on all businesses in the sector provide a very crude picture of sector development. Accordingly, vwe have disaggregated the data to show change for each subsector, and within each subsector for small, medium, and large firms as defined above.

In terms of number of firms, the largest subsectors in 1981 for both Texas and the U.S. as a whole were:

i. Knowledge Production and Inventive Industries

iii. Search and Coordination

Table 2: Growth of Information Sector Sub-Units: National

	Information Sector Sub-Units	1971	1981	Percentage Change 1971-81
I	Knowledge Production	162,733	245,806	51.05%
II	Info. Distrib. and Comm.	51,858	42,427	(18.19)
III	Search and Coordination	145,907	198,499	36.04
IV	Risk Management	93,419	150,315	60.90
V	Info. Processing and Trans.	33,681	46,289	37.43
VI	Info. Goods Manufacturing	18,017	25,275	40.28
VII	Trade in Info. Goods	23,182	33,973	42.67
	TOTAL:	528,797	741,684	40.26%

Table 3: Growth of Information Sector Sub-Units: Texas

	Information Sector Sub-Units	1971	1981	Percentage Change 1971-81
I	Knowledge Production	9,018	16,252	80.22%
II	Info. Distrib. and Comm.	3,213	2,454	(23.62)
III	Search and Coordination	8,373	13,054	55.91
IV	Risk Management	6,488	8,700	34.09
V	Info. Processing and Trans.	2,251	3,793	68.50
VI	Info. Goods Manufacturing	857	1,445	68.61
VII	Trade in Info Goods	1,224	2,178	77.94
	TOTAL:	31,424	47,876	52.35%

Table 4: Information Sector Businesses as a Percentage of Total Businesses: U.S. and Texas 1971 to 1981

	1971	1976	1981
Texas	15.1%	15.2%	15.3%
U.S.	15.1%	15.6%	16.2%

iv. Risk Management

However, in terms of growth, the fastest growing sectors in terms of number of firms were:

i. Knowledge Production and Inventive Industries

vii. Trade in Information Goods

vi. Information Goods Manufacturing

It should be noted that the growth was primarily in terms of new small businesses. The growth of knowledge production and inventive industries probably indicates the entry of new small financial, technical, and legal firms, as well as larger research and development organizations. The major increase in retailing of information technology in the form of telecommunications equipment (no longer a monopoly of the telephone company), computers and consumer electronics for individuals and businesses likely accounts for the growth in category vii. The growth of small, specialized manufacturing firms reflected in category vi denotes the entry of manufacturing entrepreneurs hoping to profit from the demand for new microchip-based technologies. The decline in category ii probably indicates consolidation of small schools as a result of relatively flat enrollments in primary schools (see Demography section below.)

Growth of medium sized firms was largest in subsectors:

v. Information Processing and Transmission Services

vi. Information Goods Manufacturing Industries

i. Knowledge Production and Inventive Industries

rowth in these categories reflects the expansion of the information processing and telecommunications industries in Texas. In addition, there has been major growth in the number of industries which produce information goods -- particularly microprocessors, , electronic components, and equipment containing microprocessors including computers, test equipment, military electronics, and consumer electronics, etc. Medium size research and development firms, including those which work on contracts primarily for the military or the space program, likely account for much of the growth in category i.

Greatest growth in the number of large businesses was in categories:

iii. Search and Coordination Industries

Table 5: Change in the Number of Information Sector Businesses in Texas: 1971 to 1981

	1971/76			1976/81			1971/81		
	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
I	25.1%	31.7%	(55.6)%	43.8%	87.3%	275%	79.8%	146.7%	66.7%
II	(9.4)%	22.2	56.2	(17.1)	(10.9)	(4.0)	(24.9)	8.9	50.0
III	29.6	19.6	100.0	19.9	96.4	75.0	55.4	134.8	250.0
IV	18.2	9.0	25.0	12.7	48.8	20.0	33.2	62.2	50.0
V	48.8	72.0	33.3	11.1	68.2	(85.0)	65.3	189.3	86.0
VI	32.9	75.0	100.0	20.8	55.9	33.3	60.4	172.9	167.0
VII	61.6	(91.7)	-	10.9	400.0	-	79.2	(58.3)	-
TOTAL:	24.7%	27.7%	38.8%	21.6%	52.6%	11.0%	51.6%	95.0%	54.1%

Table 6: Rank of Percentage Growth in Information Subsectors in Texas 1971 - 1981 by Size of Business

Information Subsector		Total Businesses	Small	Medium	Large
I	Knowledge Production	1	1	3	3
II	Info. Distrib. and Comm.	7	7	6	4
III	Search and Coordination	5	5	4	1
IV	Risk Management	6	6	5	4
V	Info. Processing and Trans.	4	3	1	6
VI	Info. Goods Manufacturing	3	4	2	2
VII	Trade in Information Goods	2	2	7	-

vi. Information Goods Manufacturing Industries

i. Knowledge Production and Inventive Industries

Category iii includes financial institutions, security and commodity exchanges, brokers, insurance agents, and advertising agencies. Growth in this sector probably reflects the major development of Texas as a financial center, and the shifting of some corporate activities from northern states to the sunbelt. THe growth of information goods manufacturing shows the expansion of large Texas based companies and the move away from Silicon Valley for manufacture of semiconductor products. The growth of large knowledge production and inventive industries may reflect Texas' incentives in terms of relatively low cost of living and favorable tax policies, as well as the presence of large contractors for the military and the space program.

5. Information Sector Occupations and Skills

What are the implications of information sector growth for employment? Levin and Rumberger (1983) estimate that national employment will increase by 23% between 1978 and 1990, and find that of the five fastest growing occupations, three -- data processing machine mechanics, computer systems analysts, and computer operators -- deal with high technology products. Employment in the five highest growth occupations is projected to increase by over 100%, more than four times the employment rate in all occupations. (See Table 7).

However, as Levin and Rumberger point out, thte total number of new jobs in these and other high technology occupations is relatively small, and will be vastly outweighed by employment growth in other areas. Of the twenty occupations expected to generate the most jobs in the economy during this period, none is related to high technology. The five occupations expected to generate the most new jobs are all in low skilled services: janitors, nurses' aides, sales clerks, cashiers, and waiters and waitresses. Only three or four of the "top 20" occupations in terms of job growth require education beyond the secondary level, and only two require a college degree (teaching and nursing).

Revised BLS estimates show that high technology occupations as a group will account for only 7% of all new jobs between 1980 and 1990 (Coleman, 1982, quoted in Levin and Rumberger). Employment in all professional and managerial occupations is projected to increase by 28% between 1980 and 1990, compared to 45% during the previous decade. Clerical and service occupations are projected to account for 40% of the employment growth during this decade. Thus, employment growth for the economy as a whole will favor jobs that require little training beyond high school. (See Table 8).

However, as we have seen above, many workers throughout the economy will be expected to use information technology in their jobs. While for some, the use of these tools may result in more challenging work requiring more advanced skills, for others jobs

Table 7: Employment and Employment Growth in the Fastest Growing Occupations: 1978-1990

Occupations	Employment (thousands) 1978	1990	Percentage Increase	Number of Jobs (thousands)	(percent of all occupations)
Fastest relative growth[a]					
1. Data processing machine mechanics	63	156	148%	93	0.4%
2. Paralegal	28	66	132	38	0.2
3. Computer systems analysts	185	384	108	199	0.9
4. Computer operators	169	317	88	148	0.7
5. Office machine and cash register servicers	49	89	81	40	0.2
Total	494	1012	105	518	2.4
Fastest absolute growth[b]					
1. Janitors	2585	3257	26	672	3.1
2. Nurses' aides and orderlies	1089	1683	55	594	2.7
3. Sales clerks	2771	3362	21	591	2.7
4. Cashiers	1501	2046	36	545	2.5
5. Waiters/Waitresses	1539	2071	35	532	2.4
Total	9485	12419	31	2934	13.3
Total, all occupations	97610	119590	23	21980	100.0

a. Based on the percentage increase in the number of jobs created

b. Based on the number of jobs created

Source: Levin and Rumberger, 1983

Table 8: Employment Growth by Major Occupation Group: 1960-1990

Major Occupation Group	Employment Growth (percentage distribution) 1960-70 (1)	1970-80 (2)	1978-90 (3)
Professional and technical	30.0%	22.3%	20.3%
Managerial	6.0	22.7	7.7
Sales	5.8	2.6	7.0
Clerical	32.9	21.0	20.0
Crafts	11.2	9.5	12.2
Operatives	7.5	1.8	10.0
Laborers	.7	4.8	4.8
Farm workers	-14.5	- .2	- 2.6
Service	20.4	15.5	20.7
Total	100.0%	100.0%	100.0%

Source: Levin and Rumberger, 1983

may become more routinized and repetitive. The key to this dichotomy lies in the management of information work. As Dirrheimer (1982) points out, extensive standardization of work will lead to polarization of tasks into administrative vs. highly repetitive, whereas diversification of work will result in upgrading of many positions to handle more diverse tasks and more discretionary decisions. Dirrheimer stresses the importance of training administrative and service workers in the potential of the equipment used in the work place, as well as in specific user skills. She also stresses training in knowledge of the objectives and organization of the company/administrative body, apparently assuming a wider range of tasks for office workers under the diversification model. However, the percentage of clerical workers whose responsibilities will be broadened vs. those whose tasks will become or remain limited and repetitive (e.g. the office manager vs. the pool typist) is as still open to speculation.

6. Significant Demographic Trends in Texas

In order to understand the impact of the growth of the information sector in Texas, it is important to examine some significant demographic charateristics. Table 9 shows that between 1970 and 1980, the population in Texas increased 27.1%, or almost two and a half times the national growth rate. Much of this growth may be attributed to immigration -- from northern states and from Mexico. In addition the ethnic compositions of Texas must also be taken into consideration; in 1970, approximately one third of the Texas population consisted of minorities -- with 12% blacks and 21% of Spanish origin.

While Texas is more urbanized than other southern or southwestern states, about 20% of its population is rural. Thus, there are now more than 3 million Texans living outside cities and major towns, and this number is likely to increase, as rural growth rates at present equal urban growth rates (likely primarily as a result of immigration from Mexico.)

Minorities in Texas are significantly poorer than whites, with the median incomes of blacks being 66% that of whites, and the median income of Hispanics being 70% that of whites. The poverty rate in Texas is higher than the national average for both individuals and families. While disaggregated data by race or ethnic group were not available for this paper, it is evident that minorities in Texas account for a disproportinate number of individuals and families below the poverty line.

Table 10 shows changes in school populations in Texas between 1960 and 1970. Although many states experienced a drop in school enrollments due to a decline in the school age population, Texas showed an increase in all age groups, due to both immigration and natural growth. However, the population in the 6 to 13 year old category rerained relatively constant, probably accouonting for the consolidation of schools which reduced the number of schools as shown in the infomration sector statistics above. (In other

Table 9: Selected Demographic Characteristics: U.S. and Texas

	U.S.	Texas
Percentage Change in Population 1970-1980		
Total	11.5%	27.1%
Urban	11.9%	27.0%
Rural	10.4%	27.3%
Percentage of Black and Spanish Origin in Population (1980)		
Blacks	11.7%	12.0%
Spanish Origin	6.4%	21.0%

Source: U.S. Bureau of the Census, General Population Statistics, 1980, Census

Table 10: Selected School Population Statistics: Texas

Age	Total Students 1970	Total Students 1980	Percentage Increase/Decrease 1970-1980	Percent Black/Spanish Origin (1980)
0-5	1,218,659	1,393,082	+14.3%	43.9%
6-13	1,876,246	1,889,176	+ 0.7%	42.6%
14-17	904,931	1,023,848	+13.1%	38.4%
18-22	1,024,506	1,418,075	+38.4%	36.5%

Source: Cullen et al., 1982

states in the region, there was a decline of as much as 11% in enrollment in this age group.) And school age populations in Texas will continue to grow, both as a result of immigration and of natural growth, as the 18 to 22 year olds shown in this table begin to raise their own families.

Table 10 also shows the influence of racial and ethnic minorities on school enrollment. Now, more than 40% of the school age population is black or Hispanic, with even higher percentages at the lower age levels.

Texas is also behind the national average in educational achievement, measured both by results on standardized tests and by the educational attainment of its residents. While approximately 65% of Texan adults have completed four years of high school, only 54% of blacks and 40% of Hispanics have this much schooling.

There are many implications of these data for state policy makers and educators concerned with planning for growth in the state's information sector. Population growth will continue to place a strain on educational facilities, and on the economy to expand enough to create enough new jobs. However, within the information sector, the number of jobs offering opportunities for advancement is likely to be limited according to the projections noted above. Preparation for these jobs will require improvements in both the quantity and quality of education now available to many Texans. The problem may be most serious for Texan minorities who already face a burden of both an income gap and an education gap; the above analysis shows that black and Hispanic Texans are poorer economically and in terms of educational achievement than their white counterparts.

With lower educational levels and standards of living, blacks and Hispanics are likely to lag behind their white counterparts in qualifying for skilled jobs in the information sector. The fact that these are growing populations through both natural increase ad immigration indicates that the problems of unemployment and underemployment and economic disparities between racial and ethnic groups are likely to be magnified.

The growth of the school age population and the increasing percentage of minorities create many demands on educators . The classroom is likely to contain children of diverse economic and cultural backgrounds, each with specific needs. Fulfillment of these needs requires revision and expansion of the curriculum, better trained teachers, and more effective teaching. All of these require more money. While computers hold considerable promise for improving learning and individual attention, they will require even greater expenditures. Yet the incentive of low taxes which is used to lure new industries to Texas perpetuates a philosphical commitment to low public expenditures on education and social services which in turn may result in a poorly educated and under-qualified workforce.

7. Conclusions

The implications of the growth of the information sector in Texas must be seen in terms of both demography and employment prospects. The number of information sector businesses in Texas increased by more than 52% between 1971 and 1981, approximately paralleling the percentage growth in total businesses. Much of the growth was in small firms in the service sector. However, it should be borne in mind that there was also significant growth in both middle size and large firms, and that an addition of one new large firm adds at least five times as many jobs as a new small firm.

What are the implications of this growth for employment in Texas? The fact that the Texas economy is still expanding faster than the national average tends to obscure the major growth in the information sector. However, state officials seem intent to accelerate the growth of high technology industry through attractive incentive packages, without considering the real implications for employment and education.

While the number of information sector jobs may increase even more in this decade than during the 1970's, the result may not be major growth in high paying highly skilled information jobs. As Levin and Rumberger (1983) point out, absolute growth may be largest in low level clerical and service jobs. However, as Dirrheimer (1982) notes, whether information jobs become more challenging or more tedious may be largely a function of how information work is managed.

While the expansion of employment opportunities appears favorable for young Texans, minorities are not likely to benefit significantly from expansion in the information sector. As we have seen, blacks and Hispanics now constitute one third of the population, and more than 40% of elementary school students. They are already behind in terms of both income and educational achievement. Unless the education gap is closed, they will find their opportunities limited to the low level low paying service jobs, with little opportunity for advancement.

The irony is that state officials seem oblivious to these trends, and view information sector growth only in the most favorable light. While much attention is now being paid to education, there appears to be little recognition of the gaps in educational opportunities within the state, particularly among minorities and rural students. While "computer literacy" is touted as the skill all students will need, educational planners might better emphasize analytical thinking and decision-making skills as well as improved achievement levels, so that Texan students will have at least an opportunity to enter challenging careers rather than dead end jobs in the information sector.

However, unless educational opportunities are equalized, and unless information work is more creatively managed to provide incentives and opportunities for advancement rather than tedious low level jobs, Texans are likely to find the touted benefits of information sector growth largely illusory.

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